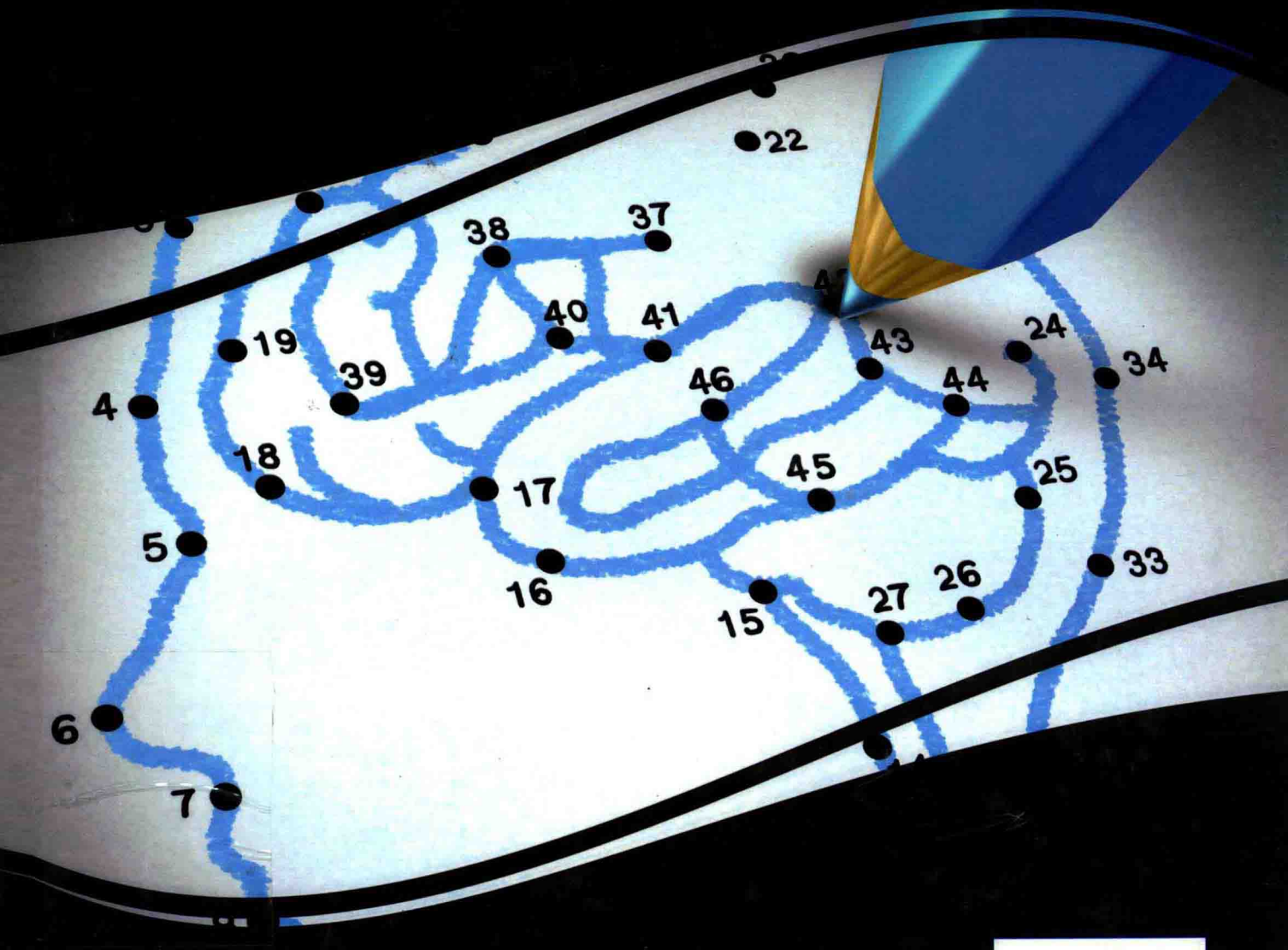
Handbook of Research on

Innovations in the Diagnosis and Treatment of Dementia



Panagiotis D. Bamidis, Ioannis Tarnanas,
Leontios Hadjileontiadis, and Magda Tsolaki

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Handbook of Research on Innovations in the Diagnosis and Treatment of Dementia

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A volume in the Advances in Psychology, Mental Health, and Behavioral Studies (APMHBS) Book Series

Medical Information Science
REFERENCE
An Imprint of IGI Global

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Typesetter: Tucker Knerr
Cover Design: Jason Mull

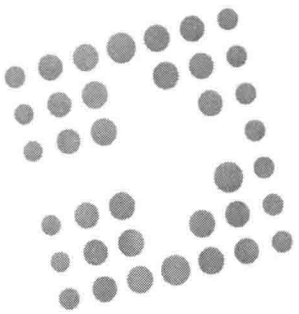
Published in the United States of America by
Medical Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA, USA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Library of Congress Cataloging-in-Publication Data

Handbook of research on innovations in the diagnosis and treatment of dementia / Panagiotis D. Bamidis, Ioannis Tarnanas, Leontios Hadjileontiadis, and Magda Tsolaki, editors.
p. ; cm.
Includes bibliographical references and index.
Summary: "This book offers empirical research and theoretical analyses on the cognitive impairment of aging, by offering emerging research, clinical practices, therapy, and technological innovations concerning the development and treatment of dementia"--Provided by publisher.
ISBN 978-1-4666-8234-4 (hardcover) -- ISBN 978-1-4666-8235-1 (ebook)
I. Bamidis, Panagiotis D., editor. II. Tarnanas, Ioannis, 1974- , author. III. Hadjileontiadis, Leontios J., editor. IV. Tsolaki, Magda, author.
[DNLM: 1. Alzheimer Disease--diagnosis. 2. Alzheimer Disease--therapy. 3. Diffusion of Innovation. 4. Self-Help Devices. WT 155]
RC523
616.8'31--dc23
2015003180

This book is published in the IGI Global book series Advances in Psychology, Mental Health, and Behavioral Studies (APMHBS) (ISSN: pending; eISSN: pending)

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.



Advances in Psychology, Mental Health, and Behavioral Studies (APMHBS) Book Series

ISSN: pending
EISSN: pending

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Information Science Reference • copyright 2015 • 337pp • H/C (ISBN: 9781466665996) • US $195.00 (our price)

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Preface

INTRODUCTION

This book is part of the Advances in Medical Technologies and Clinical Practice (AMTCP) Book Series which brings together the most recent research on the latest technology used in areas of nursing informatics, clinical technology, biomedicine, diagnostic technologies, and more. Researchers, students, and practitioners in this field will benefit from this fundamental coverage on the use of technology in clinical practices.

Technological Innovations drive advances in so-called "active and healthy aging" and play a crucial role in the "aging-in-place" process. This book offers a critical overview of technology for aging (gero-technological) studies and will suggest a new approach in the study of the relationship between aging, dementia and novel technologies. Some trajectories of analysis and theoretical models are presented to underline the different perspectives in the discipline. Critical positions highlight the lack of theoretical analysis, mainly in relation to the complex social phenomenon of normal aging or mild cognitive impairment aging related to technology. Conclusions outline a relational approach to gerotechnologies: an analysis of the interactions between technological artifacts, exer-gaming, EEG-ERP analysis, brain connectivity, brain-fitness software, users, and the context in which technologies are used. This approach expands the view from the technical potential of the technology to the way elderly people use technology, and suggests innovative care and cure strategies for healthy aging.

Book Objective

As future demographic trends point to increased pressures and demands on service industry providers addressing growing needy communities, such as the aged, and those challenged through impairment, many predict that digital technologies will play an increasing role in supplementing intervention practices and methods. The value of this book will be to introduce and describe some of the latest technologies offering therapy, rehabilitation, and more general well-being care for the elders. Included along with the work of researchers from the serious games, virtual reality, and play therapy disciplines will be the writings of digital artists who are increasing working alongside researchers and therapists to create playful and creative environments that are safe, adaptive, and offer tailored interventions. Unlike entertainment systems, the goals of alternative realities therapy and serious play demand the addition of sophisticated feedback systems that monitor user progress. These systems must encourage progress and intelligently

and progressively adapt to users' individual needs within an environment that is challenging, engaging, and user friendly for patients and health care professionals. Such systems require the evolution of new paradigms in test battery creation that take advantage of the controllable digital framework, embodied data feedback, and other opportunities uniquely offered by virtual interactive spaces.

Target Audience

The aim of this book is to provide a forum for reporting original research, review papers, and personal perspectives on the broad area of fitting technological environments to support changing life goals and lifestyle preferences of dementia. Research outcomes reported in the book might form the basis - for designers, architects, standards developers, builders, engineers, marketeers, manufacturers, medical doctors, pharmacists, decision makers, and related professionals in the health, social, business and technology professions, as well as educators - to provide the proper environment for the greatest number of demented people in a healthy aging society.

BOOK TOPICS

The book is divided into the following four sections:

Section 1: Aging and Innovations;
Section 2: Gerotechnology for Dementia: Basic Aspects, Models/Prototypes, Specific Applications, and Pilots;
Section 3: Assistive Technologies for Dementia in the Home and Environment; and
Section 4: Gerotechnology, Care Giver Support, Ethics, and Business Planning.

Section 1: Aging and Innovations

This section begins with a chapter by Zygouris and Tsolaki, "New Technologies and Neuropsychological Evaluation of Older Adults: Issues and Challenges," in which new technologies are brought face to face with neuropsychological evaluation of older adults. Issues and challenges stemming from the plethora of computerized instruments used nowadays for screening are discussed in the light of the need for in-depth evaluation of a wide range of cognitive disorders ranging from mild cognitive impairment (MCI) to Alzheimer's disease and various dementias. Despite currently faced problems and issues, it is believed that neuropsychological testing is moving forward in the digital era and in the future one should expect short, self-administered tests to become the norm in cognitive health.

In the next chapter, "Personal Training: Can Genes Guide Us?," Tsolaki presents current data about AD risk factors, biomarkers, risk genes, available treatments. It also focuses on current and future perspectives about the use of personalized, non-pharmaceutical computer-based interventions.

The latter is taken into account in the following chapter, "Graceful Ageing: Exergaming as a Means to Delay Mental and Physical Decline among the Elderly," by Astaras, which provides a review of pilot studies and clinical trials which have been performed to date on serious gaming (exergaming) for the

elderly. The author considers "a pre-emptive approach" in these studies in the sense that the goal is to help elderly maintain physical and mental fitness, in order to maximise the number of years that they can live independently at their own residence.

In the final chapter of this section, "Neuroimaging Approaches for Elderly Studies," Styliadis, et al. present neuroimaging methods along with findings that are particularly relevant for the study of neuroplasticity in the aging brain. The message is that information on the integrity of the cerebral structure and function will aid in the early detection and treatment of the Alzheimer's disease as well as the evaluation and track of the disease's progression.

Section 2: Gerotechnology for Dementia: Basic Aspects, Models/Prototypes, Specific Applications, and Pilots

In the chapter, "Cognitive Exercising for Patients with MCI Using Serious Games: Design of a Pilot Study," Tarnanas et al test serious gaming technologies with cognitively impaired seniors and show them to improve performance in specific cognitive functions such as working memory, dual task performance, and visual conjunction search.

The chapter, "A Review of Interventions with Assistive Technologies for Patients with Cognitive Impairment," by Georgakopoulos et al. is an attempt to review Gerotechnological advances in a systematic way, by focusing on observations of current software engineering systems (computer based assistive interventions) that contribute to the diagnosis and treatment of patients with cognitive problems, following a holistic approach.

The chapter, "Implementing Cognitive Exercises in Electronic Form for Supporting Patients with Alzheimer's Disease: The Greek Case," by Chaldogeridis et al. focuses on the transferring of paper-and-pencil cognitive exercises to an electronic form; enriched with multimedia and other interactions that cannot be achieved in the printed form. Computer-based cognitive exercises can feature adjustable difficulty levels as well as variable speed, images, and audio cues, which can help accelerate the processing of results for psychologists.

In their chapter, "Enabling Accessibility Features in Enhanced VR Environments for Supporting Spatial Abilities and Social Interaction in Elderly and MCI Patients," Segkouli et al. (2014) look at the problem of enabling accessibility features in technological environments for supporting spatial abilities and social interaction in elderly and MCI patients. They specifically examine enhanced virtual reality environments like that of Second Life.

In her chapter, "Integrated Care: Technologies for Diagnosis and Treatment," Lewy describes how the development of new technologies enable caregivers (e.g. healthcare, welfare, community) to receive important, urgent information so that they can provide patients/elderly persons with timely, personalized intervention.

The following chapter, "Decision Support in the Elderly Healthcare: Combing Short- and Long-Term Analysis Aspects," by Billis et al. discusses organizational-level decision support issues that can impact an integrated care approach; namely, the open questions regarding health monitoring in ambient assisted living environments. The chapter proposes an approach to characterize patients' overall health by combining both short-term and long-term trends. By integrating these two types of temporal informa-

tion regarding the health status of seniors, one can safeguard that both emergency detection and early diagnosis of health deterioration would lead to increased feelings of safety and quality of life from the seniors' perspective.

This section concludes with, "Robot Programming and Tangible Interfaces for Cognitive Training," where Demetriadis et al. present the conceptual framework, research rationale, and preliminary outcomes of an innovative research agenda. The chapter explores the use of tangible interfaces and robot programming tasks as a method for providing cognitive training to patients with memory dysfunctions. The main argument behind this exciting approach is that when programming tasks and relevant tangible systems are used for cognitive training, they can activate and strengthen the user's logical-analytical and visuo-spatial skills, which may sharpen the patient's cognition thereby improving his/her performance in daily activities.

Section 3: Assistive Technologies for Dementia in the Home and Environment

The opening chapter of section 3, "An Ambient Intelligence System for the Monitoring, Empowerment and Disease Evolution Prediction for Patients with Mild Cognitive Impairment" by Votis et al. addresses the critical issue of exploration and integration of environmental factors as well as the effect of activities of daily living with medical and biological factors in order to monitor and predict AD/MCI disease progression and evolution. The authors propose a system that uses ubiquitous and unobtrusive technology tools to monitor specific cognitive and physical/motor parameters as well as activities of daily livingin order to improve the diagnosis of dementia and mild cognitive impairment.

In their chapter, "Towards an HCI-Based Symbiotic Environment for Alzheimer's Support," Hadjileontiadis et al. present Symbiosis, a symbiotic human-computer interaction (HCI) environment as a means to facilitate, understand, and incorporate the needs of the whole dementia community (patients as well as doctors, caregivers, family, etc.). The HCI environment involves cutting-edge technologies, custom-designed serious games, and natural user interface, embedded within an innovative design framework.

The chapter, "Assistive Technologies for People with Dementia," by Xenakidis et al. presents and discusses the available assistive tools for people with dementia symptoms and cognitive decline. The chapter's argument is that these tools maybe replaced by mobile applications for smart devices; however, to properly design such systems one must carefully select appropriate requirement collection methodologies.

The chapter, "Unobtrusive Smart Environments for Independent Living and the role of Mixed Methods in Elderly Healthcare Delivery: The USEFIL Approach," by Astaras and colleagues provides an overview of the USEFIL research project: an approach to elderly healthcare delivery through **U**nobtrusive **S**mart **E**nvironments for **I**ndependent **L**iving . The chapter refers to studies and efforts spent within the realm of the USEFIL project, which is revisited in later chapters of this book.

In their chapter, "Unobtrusive Low-Cost Physiological Monitoring Using Visual Information," Petridis et al. consider the unobtrusive monitoring of elderly people using common low-cost hardware and describe efficient visual analysis methods towards real-time approaches for pupil size estimation and pulse rate estimation.

In "Reviewing Home Based Assistive Technologies," Bamidis et al. review home based assistive technologies but with a notion towards both the technical as well as on the application fronts based on recent literature. Examples from projects and use cases are also included here. The chapter features a case study of the USEFIL system previously introduced in chapter 15.

In "Instrumenting the eHome and Preparing Elderly Pilots: The USEFIL Approach," Antoniou et al explore how to instrument the home of the senior living alone, so that unobtrusive monitoring takes places and improves his/her feelings of security and improve the quality of his/her life. Emphasis is drawn on technical information that facilitates pre-trialing the system in an e-home setup before going into actual homes of seniors living alone.

In the chapter, "Recognizing Physical Activities using Wearable Devices," Khan and Lawo describe how to use mobile devices for identifying a few physical activities (i.e. lying, sitting, walking, standing, cycling, running, ascending stairs and descending stairs), as well as some fitness studio activities (i.e. using elliptical trainer, butterfly, bench-press and pull down) and swimming techniques (i.e., dolphin, back-stroke, breast-stroke and free-style) using machine learning algorithms. They present an approach to build a system that exhibits this property and provides evidence based on user studies.

The section concludes with the chapter, "Unobtrusive Wearable Technology for Health Monitoring" by Amor and James, which presents an overview of unobtrusive monitoring using wearable devices. The authors discuss some common device types and data and recommend some factors to consider when choosing or designing a device for unobtrusive patient monitoring.

Section 4: Gerotechnology, Care Giver Support, Ethics, and Business Planning

The last part of this book puts emphasis of gerotechnologies for the caregiver. It also deals with business spin-off capacities of all the previously presented technologies by providing a few relevant case examples from specific projects funded by the European Commission.

In the chapter, "ICT Support to Those Providing Care to Elderly: Pilot Training Activities in Greece in the Realm of the DISCOVER Project," Sidiropoulos et al. discuss the training needs of caregivers of the elderly with respect to Information and Communication Technologies (ICTs). Taking into account the carers' digital skills diversity, the chapter emphasises on efforts which include a broad range of skill and content learning needs, which is part of the DISCOVER project that aims to develop competencies for EU carers.

In the chapter, "Spinning Off Business Activities for Care Giver Support: The DISCOVER Attempt," Vontas et al. revisit the DISCOVER project, using it as a case example to explore the process of creating business activities from such kind of projects.

In the final chapter in the book, "Spinning off Gerotechnology Business Activities: The LLM Care Best Practice Paradigm," Romanopoulou and colleagues describe how they approached a similar method to pilot spin-off business activities related to cognitive and physical training for the elderly so that gero-technology innovations can spread around the globe. The case for LLMcare and Greece is given as an example to mimic.

FUTURE OUTLOOK AND A FINAL NOTE FOR READERS OF THIS BOOK

From the presentation of all these topics and issues governing the wider area of gerotechnology one thing becomes crystal clear: innovations and technology are already leading the way forward to the diagnosis and treatment of dementia. An effort has been spent on this book to cover not only theoretical aspects by reviewing the domain, but also to provide specific reference to example case and products that have been or are being tested at the time of writing. It is the Editors' wish that all these efforts are stemmed by success and a step further is achieved in the fight against cognitive decline and dementia. Despite this fact, readers of this book should always bear in mind that the material presented herein is always limited by one very fact: technology runs so fast, that even quite recent achievements to be regarded as obsolete in a year's time. However, one thing is true for this book and makes it worth reading: it provides acomprehensive view of gerotechnological innovations for diagnosis and treatment of dementia and quite a few case examples are illustrated by all authors. Very rarely do readers find such a diversity of information in one place in such a granular arrangement.

So, enjoy reading this book. We hope you find it useful!

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Section 2
Gerotechnology for Dementia: Basic Aspects, Models/Prototypes, Specific Applications, and Pilots